DESCRIPTION

EGR COOLER

Technical Field

[0001]

The present invention relates to an EGR cooler attached to an EGR apparatus, which recirculates exhaust gas from an engine to suppress generation of nitrogen oxides, so as to cool the exhaust gas for recirculation.

Background Art

[0002]

Known is an EGR apparatus which recirculates part of exhaust gas from an engine in a vehicle or the like to the engine to suppress generation of nitrogen oxides. Some of such EGR apparatuses are equipped with, midway of an exhaust gas recirculation line to the engine, an EGR cooler for cooling the exhaust gas since cooling the exhaust gas to be recirculated to the engine will drop the temperature of and reduce the volume of the exhaust gas to lower the combustion temperature in the engine without substantial decrease in output of the engine, thereby effectively suppressing generation of nitrogen oxides.

[0003]

Fig. 1 is a sectional view showing an example of the EGR coolers in which reference numeral 1 denotes a cylindrical shell with axially opposite ends to which plates 2 are respectively fixed to close the ends of the shell 1. Penetratingly fixed to the respective plates 2 are opposite ends of a number of tubes 3 which extend axially within the shell 1.

[0004]

The shell 1 is provided with a coolant-water inlet pipe 4 near one end of the shell 1 and with a coolant-water outlet pipe 5 near the other end of the shell 1 so that coolant water 9 is fed via the inlet pipe 4 into the shell 1, flows outside of the tubes 3 and is discharged via the outlet pipe 5 from the shell 1.

[0005]

The respective plates 2 have, on their sides away from the shell 1, bowl-shaped hoods 6 fixed to the respective plates 2 so as to enclose end faces of the plates. The one and the other hoods 6 provide central exhaust-gas inlet and outlet 7 and 8, respectively, so that exhaust gas 10 from the engine enters via the inlet 7 into the one hood 6, is cooled during passage through the number of tubes 3 by means of heat exchange with coolant water 9 flowing outside of the tubes 3 and is discharged to the other hood 6 to be recirculated via the outlet 8 to

the engine.

[0006]

In such conventional EGR cooler, a flow tends to be formed which, after entering via the inlet pipe 4 into the shell 1, is directed diagonally by a most direct way to the outlet pipe 5. Thus, mere formation of the inlet and outlet pipes 4 and 5 does not prevent coolant water 9 from stagnating near a corner in the shell 1 opposite to the inlet pipe 4, so that a bypass outlet pipe 5a is provided at a position diametrically opposite to the inlet pipe 4 to extract part of the coolant water 9 from there and prevent the coolant water 9 from stagnating, whereby lowering of heat exchange efficiency and resultant local thermal deformation of the tubes 3 there can be prevented from occurring.

[0007]

The following References 1 and 2 are prior applications relating to similar EGR coolers and filed by the same applicants as those in this invention.

[Reference 1] JP 2002-327654A

[Reference 2] JP 2000-045884A

Summary of The Invention

Problems to be Solved by the Invention

[0008]

However, the conventional bypass outlet pipe 5a serves also as air vent for discharge of air admixing in the shell 1. As a result, the coolant water inlet pipe 4 and the bypass outlet pipe 5a must be vertically oppositely arranged such that the latter is above the former. Thus, disadvantageously, mounted posture of an EGR cooler to a vehicle has been restricted.

[0009]

The prevent invention was made in view of the above and has its object to prevent coolant water from stagnating without restricting mounted posture of an EGR cooler to a vehicle.

Means or Measure for Solving the Problems

[0010]

The invention is directed to an EGR cooler comprising tubes and a shell surrounding said tubes, coolant water being fed into and discharged from said shell, exhaust gas being passed through said tubes for heat exchange of said exhaust gas with said coolant water, characterized in that an annular coolant-water supply chamber is fitted over said shell near an axial end of said shell, a coolant-water inlet pipe being connected to a periphery of the supply chamber, communicating holes being formed at a plurality of peripheral positions on the shell surrounded

by said supply chamber such that the holes have gradually reduced diameters as said holes are peripherally apart from the connection between the chamber and the inlet pipe so as to substantially evenly introduce the coolant water into the shell via the holes.

[0011]

Thus, the coolant water fed via the inlet pipe into the supply chamber is distributed all over the periphery of the supply chamber and is substantially evenly introduced via the respective communicating holes in a dispersed manner, so that the coolant water is prevented from stagnating near the axial end of the shell.

[0012]

Even if the EGR cooler is mounted on the vehicle in such a posture that the coolant-water inlet pipe is not directed upward, the highest one of the plural communicating holes sequentially arranged along the periphery of the shell serves as air vent for discharge of the air out of the shell, so that the EGR cooler may be freely displaced around an axis of the shell into any posture.

[0013]

In the invention, preferably, it is ensured that a portion of the shell surrounded by the supply chamber has a required extent of peripheral zone facing the inlet pipe

and having no communicating holes; then, the coolant water fed via the inlet pipe firstly impinges against the zone with no communication holes to be satisfactorily divided into two, whereby the coolant water is efficiently distributed all over the periphery of the supply chamber.

Effects of the Invention

[0014]

The following excellent effects will be obtained according to an EGR cooler of the invention. The coolant water can be fed into the shell substantially evenly via the communicating holes in a dispersed manner to prevent the coolant water from stagnating; as a result, efficiency in heat exchange between the exhaust gas and the coolant water is substantially enhanced to surely prevent the tubes from being thermally deformed due to local high temperature. Moreover, the EGR cooler may be displaced around the axis of the shell into any posture to freely change the direction of the inlet pipe; as a result, restriction of the mounted posture of the EGR cooler to the vehicle may be substantially relieved in comparison with the prior art.

Brief Description of Drawings

[0015]

[Fig. 1] A sectional view showing an example of a conventional EGR cooler.

[Fig. 2] A sectional view showing an embodiment of the invention.

[Fig. 3] A sectional view looking in the direction of arrows III in Fig. 2.

[Fig. 4] A sectional view of the EGR cooler in a mounted posture different from that in Fig. 3.

[Fig. 5] A sectional view of the EGR cooler in a mounted posture further different from that in Fig. 3.

Explanation of Reference Numerals

[0016]

1 shell

3 tube

4 coolant-water inlet pipe

5 coolant-water outlet pipe

9 coolant water

10 exhaust gas

11 coolant-water supply chamber

12 communicating hole

13 zone with no communicating holes

Best Mode for Carrying Out the Invention

[0017]

An embodiment of the invention will be described with reference to the drawings.

[0018]

Figs. 2-5 shows an embodiment of the invention in which parts similar to those in Fig. 1 are represented by the same reference numerals.

[0019]

As shown in Figs. 2 and 3, in the EGR cooler according to the embodiment, an annular coolant-water supply chamber 11 is fitted over a shell 1 near an axial end of said shell (near the left end of the shell in Fig. 2); a coolant-water inlet pipe 4 is connected to a periphery of the supply chamber 11 (a lowermost portion in the figure); and communicating holes 12 are formed at a plurality of peripheral positions on a portion of the shell 1 surrounded by the supply chamber 11 such that the holes have gradually reduced diameters as they are peripherally apart from the connection of the chamber with the inlet pipe 4 so as to introduce the coolant water 9 into the shell 1 substantially evenly via the holes 12.

[0020]

Moreover, it is ensured that the portion of the shell 1 surrounded by the supply chamber 11 has a required extent of peripheral zone 13 facing the inlet pipe 4 and having no communicating holes 12.

[0021]

In the embodiment shown, an annular coolant-water discharge chamber 14 is also fitted over the shell 1 near the other axial end of the shell 1 (near the right end of the shell in Fig. 2); a coolant-water outlet pipe 5 is connected to a periphery of the discharge chamber 14 (an uppermost portion in the figure); and communicating holes 15 are formed at a plurality of peripheral positions on the portion of the shell 1 surrounded by the discharge chamber 14. However, alternatively, only the coolant-water outlet pipe 5 may be provided as in the prior art.

[0022]

This is because, on the discharge side of the coolant water 9, the heat exchange has been substantially finished so that temperature difference between the exhaust gas 10 and the coolant water 9 is no more great and there is no fear of the tubes 3 becoming locally high-temperature due to stagnation of the coolant water 9; stagnation of the coolant water 9 can be substantially disregarded there.

[0023]

Thus, the coolant water 9 fed via the inlet pipe 4 into the supply chamber 11 firstly impinges against the zone with no holes and is satisfactorily divided into two, and is efficiently distributed all over the supply chamber 11; as a result, it is introduced into the shell 1

substantially evenly via the respective communicating holes 12, so that the coolant water 9 is prevented from stagnating near the one axial end of the shell 1.

[0024]

Even if the EGR cooler is mounted on the vehicle at such a posture that the coolant water inlet pipe 4 is not directed upward, the highest one of the plural communicating holes arranged serially along the periphery of the shell 1 serves as air vent for discharge of air out of the shell 1, so that it is for example possible, as shown in Figs. 4 and 5, to displace the EGR cooler around the axis of the shell 1 into any posture so as to freely change the direction of the inlet pipe 4.

[0025]

Thus, according to the above-mentioned embodiment, the coolant water 9 can be introduced into the shell 1 substantially evenly via the respective communicating holes 12 so as to prevent formation of stagnation. As a result, efficiency in heat exchange between the exhaust gas 10 and the coolant water 9 is substantially enhanced to surely prevent the tubes 3 from being thermally deformed due to local high temperature. Moreover, since the EGR cooler may be displaced about the axis of the shell 1 into any posture to freely change the direction of the inlet pipe 4, then restriction of the mounted posture

to the vehicle can be substantially relieved in comparison with the prior art.